
2013 Residential Alternative Calculation Method (RACM) – Approval Manual (DRAFT)

CALIFORNIA ENERGY COMMISSION

Robert B. Weisenmiller, Ph. D.

Chairman

Commissioners:

James D. Boyd

Karen Douglas

Carla Peterman

Melissa Jones

Executive Director

Panama Bartholomy

Deputy Director

**ENERGY EFFICIENCY AND
DEMAND ANALYSIS
DIVISION**

G. William Pennington,

Manager

**BUILDINGS AND
APPLIANCES OFFICE**

Maziar Shirakh, P.E.

Project Manager

Rob Hudler,

Technical Lead

**BUILDINGS AND
APPLIANCES OFFICE**

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1. Overview of Process

This Residential Alternative Calculation Method (RACM) Approval Manual explains the requirements for approval of residential Alternative Calculation Methods (ACMs or compliance software). Residential compliance software is used to demonstrate compliance with the performance approach to the California Energy Efficiency Standards for Low-Rise Residential Buildings as outlined in Title 24, Part 6, Subchapter 8, § 151. The Energy Commission develops and implements the Efficiency Standards.

The purpose and policy of this RACM Approval Manual is to specify the California Energy Commission approval process for residential compliance software and to define the assumptions and procedures of the reference method against which compliance software will be evaluated. The performance compliance requirements and procedures apply to low-rise residential buildings. A separate Nonresidential Alternative Calculation Method (NACM) Approval Manual addresses nonresidential buildings, hotels & motels, and high-rise residential buildings. The procedures and processes described in this manual are designed to preserve the integrity of the performance compliance process.

The vendor conducts the specified tests, evaluates the results and certifies in writing that the compliance software passes the tests. The California Energy Commission (Commission) will perform spot checks and may require additional tests to verify that the proposed compliance software is suitable for compliance purposes. The vendor is required to develop a compliance supplement (program user manual) explaining how to use the program for showing compliance with the standards. The compliance supplement will also be checked by the Commission for accuracy and ease of use.

When energy analysis techniques are compared, there are two basic sources of discrepancies: differences in user interpretation when entering the building specifications, and differences in the compliance software's algorithms for estimating energy use. The approval tests in this manual are designed to minimize differences in interpretation by providing explicit detailed descriptions of the test buildings that shall be analyzed.

1.1 Application Checklist

The following is a checklist of all the items that shall be included in an application package for compliance software. Some materials are required only for general purpose compliance software and are so indicated.

- Compliance software Vendor Certification Statement. A statement from the compliance software vendor certifying the compliance software, and, its reliability and accuracy when used for compliance purposes (see Residential ACM Reference Manual Appendix A).
- Computer Run Summary Sheets. Hard copy summary sheets of all the required computer runs (see Residential ACM Reference Manual Appendix A).
- Computer Runs. Copies of the computer runs specified in Chapters 4 and 5 of the RACM Reference Manual, including complete input and output files, on diskettes or in computer readable form acceptable to the Commission to enable spot checks.
- Compliance Supplement. A copy of the Compliance Supplement discussed in Chapter 7 of the RACM Reference Manual. The Compliance Supplement and the Compliance software User's Manual may be combined into the same document.
- Copy of the compliance software. A computer readable copy of the compliance software (in a format agreed to by the Commission staff) for verification of analyses and random verification of compliance analyses. Weather data shall be included.
- Application Fee. An application fee of \$2,000.00 (two thousand dollars) is required to cover costs of evaluating the application.

1.2 Types of Approval

This RACM Standard addresses three types of compliance software approval: full approval, streamlined approval of new program features, and amendments to full approvals.

1.2.1 Full Approval

Full approval is required when a candidate compliance software has never been previously approved by the Commission, and/or when the compliance software vendor makes changes to the executable program code or algorithms, or any other change that in any way affects the results. The Commission may also require that all compliance software be approved again when the standards are updated on the three-year cycle or whenever substantial revisions are made to the approval process, for instance, if new analysis capabilities come into widespread use, and the Commission declares them to be minimum capabilities for all compliance software.

When re-approval is necessary, the Commission will notify all compliance software vendors of the timetable for renewal. There will also be a revised compliance software Approval Manual published, with complete instructions for re-approval.

Full approval is required for all compliance software changes, unless they qualify for the streamlined approval process or for an addendum, as discussed below.

1.2.2 Streamlined Approval

Certain types of changes may be made to approve residential compliance software through a streamlined procedure. Examples of changes that qualify for streamlined approval are modifications to the user interface or implementation on a different operating system as long as there are no changes to the executable program code that would in any way affect the results.

If a compliance software modification qualifies for streamlined approval, then the following procedure is followed:

- The compliance software vendor shall prepare an addendum to the compliance supplement, when appropriate, describing the change to the compliance software.
- The compliance software vendor shall notify the Commission by letter of the change. The letter shall describe in detail the nature of the change and why it is being made. The notification letter shall be included in the Compliance Supplement.
- The compliance software vendor shall provide the Commission with an updated copy of the compliance software and include any new reports created by the compliance software (or modifications in the standard reports).
- The Commission will respond within 45 days. The Commission response may take several forms. The Commission may request additional information, refuse to approve the change or require that the compliance software vendor make specific changes to either the Compliance Supplement addendum or the compliance software.

With Commission approval, the vendor may issue new copies of the compliance software with the Compliance Supplement addendum and notify compliance software users and building officials.

1.2.3 Amendments

Compliance software approval shall be amended when optional modeling capabilities are added. The vendor shall provide the additional computer runs required for the optional modeling capability. It is not necessary to include computer runs previously submitted.

An amendment to approved compliance software shall be accompanied by a cover letter explaining the type of amendment requested, and copies of other documents as necessary. All items on the application checklist

should be submitted, when applicable. The timetable for approval of amendments is the same as for full approval.

1.2.4 When Approval Is Not Required

Changes that do not affect compliance with the Energy Efficiency Standards for residential buildings do not require full or streamlined approval. However, the compliance software vendor shall notify the Commission and provide the Commission with an updated copy of the program and user manual. Re-approval is required for any compliance software program change that affects the energy use calculations for compliance, the modeling capabilities for compliance, the format and/or content of compliance forms, or any other change which would affect a building's compliance with the Standards. Any questions regarding applicable approval procedures should be directed to the Commission.

1.3 Challenges

Building officials, program users, program vendors or other interested parties may challenge any residential compliance software approval. If any interested party believes that a compliance program, an algorithm, or method of calculation used in a compliance program, a particular capability or other aspect of a program provides inaccurate results, the party may challenge the program.

1.4 Decertification of Compliance Software

The Commission may decertify (rescind approval of) an alternative calculation method through various means:

- All compliance software are decertified when the standards undergo substantial changes, which usually occurs every three years.
- Any compliance software can be decertified by a letter from the compliance software vendor requesting that a particular version (or versions) of the compliance software be decertified. The decertification request shall briefly describe the nature of the program errors or "bugs" which justify the need for decertification.
- Any "initiating party" may commence a procedure to decertify a compliance software according to the steps outlined below. The intent is to include a means whereby serious program errors, flawed numeric results, improper forms and/or incorrect program documentation not discovered in the certification process can be verified, and use of the particular compliance software version discontinued. In this process, there is ample opportunity for the Commission, the compliance software vendor and all interested parties to evaluate any alleged errors in the compliance software program.

Following is a description of the process for challenging compliance software or initiating a decertification procedure:

1. Any party may initiate a review of compliance software's approval by sending a written communication to the Commission's Executive Director. (The Commission may be the initiating party for this type of review by noticing the availability of the same information listed here.)

The initiating party shall:

- (a) State the name of the compliance software and the program version number(s) which contain the alleged errors;
- (b) Identify concisely the nature of the alleged errors in the compliance software which require review;
- (c) Explain why the alleged errors are serious enough in their effect on analyzing buildings for compliance to justify a decertification procedure; and
- (d) Include appropriate data electronically (in a format agreed to by the Commission staff) and/or information sufficient to evaluate the alleged errors.

2. The Executive Director shall make a copy or copies of the initial written communication available to the compliance software vendor and interested parties within 30 days. Comments from interested parties must be received within 60 days of the acceptance of the original application.
3. Within 75 days of receipt of the written communication, the Executive Director may request any additional information needed to evaluate the alleged compliance software errors from the party who initiated the decertification review process. If the additional information is incomplete, this procedure will be delayed until the initiating party submits complete information.
4. Within 75 days of receipt of the initial written communication, the Executive Director may convene a workshop to gather additional information from the initiating party, the compliance software vendor and interested parties. All parties will have 15 days after the workshop to submit additional information regarding the alleged program errors.
5. Within 90 days after the Executive Director receives the application or within 30 days after receipt of complete additional information requested of the initiating party, whichever is later, the Executive Director shall either:
 - (a) Determine that the compliance software need not be decertified; or
 - (b) Submit to the Commission a written recommendation that the compliance software be decertified.
6. The initial written communication, all other relevant written materials and the Executive Director's recommendation shall be placed on the consent calendar and considered at the next business meeting after submission of the recommendation. The matter may be removed from the consent calendar at the request of any person.
7. If the Commission approves the compliance software decertification, it shall take effect 60 days later. During the first 30 days of the 60 day period, the Executive Director shall send out a Notice to Building Officials and Interested Parties announcing the decertification.

All initiating parties have the burden of proof to establish that the review of alleged compliance software errors should be granted. The decertification process may be terminated at any time by mutual written consent of the initiating party and the Executive Director.

As a practical matter, the compliance software vendor may use the 180 to 210-day period outlined here to update the compliance software program, get it re-approved by the Commission, and release a revised version that does not contain the bugs initially brought to the attention of the Commission. Sometimes the compliance software vendor may wish to be the initiating party to ensure that a faulty program version is taken off the market.

1.5 Compliance Software Tests

This Manual provides tests to verify that compliance software are accurate. These tests are provided in Chapters 4 and 5 of the RACM Reference Manual. The compliance software vendor may propose alternate tests when the vendor believes that one or more of the standard tests are not appropriate for the compliance software. Alternate tests will be evaluated by the Commission and will be accepted if they are considered reasonable. If accepted, the alternate test(s) will be added to the RACM Reference Manual as an addendum and the alternate test(s) will be available for use by all compliance software. The alternate test will coexist with the standard test presented in the RACM Reference Manual until the Manual is revised. When a new version of the Manual is produced, the alternative test may be substituted for the current test or may continue to coexist with the original test.

1.6 Approval of New Exceptional Methods

The Commission may approve new exceptional methods. Exceptional methods are special modeling capabilities or calculation methods necessary to recognize building features that cannot be adequately modeled with existing compliance software. When an Exceptional Method is approved, a new optional

capabilities test may be approved as part of the process. Exceptional Methods do not necessarily produce optional capabilities for compliance software. For instance, radiant heating systems are recognized by an adjusted equipment efficiency that may be used directly in compliance software or other compliance methods. To be approved for the new optional capability, vendors shall amend their compliance software approval.

Even if the compliance software already incorporates the Exceptional Method, the vendor shall receive approval to use the Exceptional Method in the compliance process. The compliance software vendor shall demonstrate that the compliance software automatically uses the correct fixed and restricted inputs for the Exceptional Method and that the standard reports identify the building feature(s) recognized by the Exceptional Method. Additionally, the ACM compliance supplement shall be updated, referencing the use of the new Exceptional Method.

To receive a copy of the Exceptional Method contact the Building and Appliances Office at (916) 654-4064.

1.7 RACM Reference Manual

The Commission will approve a Residential Alternative Calculation Method Reference Manual as a guidance document for the implementation of these RACM approval process. The RACM Reference Manual will set forth the specific modeling rules to be used by compliance software, how optional modeling capabilities shall be incorporated, and the details of the required help system for compliance software.

The Reference Manual also sets forth the specific requirements that must be met by compliance software to be certified by the Energy Commission for use in the Building Energy Efficiency Standards compliance process.

Other technical details guiding the development, performance, and certification of compliance software may be added to the Reference Manual, with approval of the Commission, as is necessary to achieve the goals of the Alternative Calculation Method approval process.

2. Required Compliance Software Capabilities

2.1 Overview

Chapter 3 of the RACM Reference Manual specifies required capabilities that compliance software will be tested for and specifies how the reference computer simulation program will be used for required modeling capabilities. All of the required capabilities are described in terms of the capabilities and algorithms of the Commission's reference program. Compliance software shall account for the energy performance effects of all of the features described in Chapter 2 of the RACM Reference Manual.

2.2 Modeling Procedures and Assumptions

The modeling procedures and assumptions described in Chapter 3 of the NACM Reference Manual apply to both the standard design and proposed design. The requirements for the standard design include those that compliance software shall apply to new features, altered existing features, unchanged existing features or all of the above. In order for compliance software to become approved, it shall, at a minimum, accept all of the required inputs and meet the test criteria when compared against the reference computer program using procedures and assumptions as required in the sections describing the capabilities.

2.3 Standard Reports

For consistency and ease of enforcement, the manner in which building features are reported by compliance software is standardized. All residential compliance software shall automatically produce standardized compliance reports. Chapter 2 of the RACM Reference Manual specifies the required reports and format needed for certification. In the case that the reports need to be modified in the future, the Energy Commission shall provide the necessary .dll computer files and the vendor will be required to incorporate changes to the compliance software. The frequency of the changes shall not be more than every six months.

3. Optional Capabilities

3.1 Vendor Defined Optional Capabilities

Vendors may propose other optional capabilities not specifically described in this standard. Refer to Chapter 1 of the RACM Reference Manual for additional information. In the proposal for vendor specified optional capabilities, the vendor shall include:

- Theoretical background and simulation algorithms
- Testing data and validation analysis for all specified capabilities
- Standard and proposed design assumptions
- Specific documentation requirements, addressing enforceability by building department personnel.

4. User's Manual and Help System Requirements

All RACM compliance software must include a user's manual & help system that is structured in accordance with Chapter 4 of the RACM Reference Manual.

Each compliance software vendor is required to publish a compliance supplement or an independent user's manual which explains how to use the compliance software for compliance with the Standards. The manual may also exist in electronic form, either on the user's workstation or web enabled. The document shall deal with compliance procedures and user inputs to the compliance software. Both the Compliance Software and the User's Manual and Help System shall positively contribute to the user's ability and desire to comply with the Standards and to the enforcement agency's ease of verifying compliance. The Compliance Software User's Manual and Help System should minimize or reduce confusion and clarify compliance applications. The Commission may reject a compliance software whose Compliance Software User's Manual and Help System does not serve or meet these objectives.

5. Reference Method Comparison Tests

For compliance software to be certified by the Commission, the software must pass the reference method comparison test procedures set forth in Chapter 5 of the RACM Reference Manual.

This chapter explains the methods used to test the modeling and input capabilities of compliance software relative to the reference program. The compliance software shall be able to accept all required inputs but it need not be capable of modeling all features as long as it automatically fails proposed designs with features beyond its accurate modeling capabilities. For example, a simplified calculation method modeling only single zone HVAC systems could be approved if it automatically fails proposed designs that enter multi-zone HVAC systems for the proposed design. For compliance software with limited capabilities, the vendor shall inform

users that the compliance software is not capable of modeling certain features. While most of the tests are performed in three climate zones, some of the tests use other climate zones. All the runs described in this chapter shall be performed with the compliance software, and run results shall be summarized on the forms contained in RACM Reference Manual Appendix A.

6. Vendor Requirements

Each compliance software vendor shall meet all of the following requirements as part of the compliance software approval process and as part of an ongoing commitment to users of their particular program.

6.1 Availability to Commission

All compliance software vendors are required to submit at least one fully working program version of the compliance software to the California Energy Commission. An updated copy or access to the approved version of the compliance software shall be kept by the Commission to maintain approval for compliance use of the compliance software.

The Commission agrees not to duplicate the compliance software except for the purpose of analyzing it, for verifying building compliance with the compliance software, or to verify that only approved versions of the compliance software are used for compliance.

6.2 Enforcement Agency Support

Compliance software vendors shall provide a copy of the compliance software User's Manual and Help System to all enforcement agencies who request one in writing.

6.3 User Support

Compliance software vendors shall offer support to their users with regard to the use of the compliance software for compliance purposes. Vendors may charge a fee for user support.

6.4 Compliance Software Vendor Demonstration

The Commission may request compliance software vendors to physically demonstrate their program's capabilities. One or more demonstrations may be requested before approval is granted

7. Compliance Supplement

Each Compliance Software vendor is required to publish a Compliance Supplement to the normal software users' manual. This requirement may be met with a help manual incorporated into the software, however, a printed version of the help manual which include all help items must be submitted with the application. The Compliance Supplement serves two major purposes. First, it helps building permit applicants to use the Compliance Software correctly and to prepare complete documentation of their analyses. Second, it helps building officials to check permit applications for compliance with the low-rise residential Building Energy Efficiency Standards. As a result, it helps to assure that both the performance standards and the Compliance Software are used properly.

The Compliance Supplement shall describe the specific procedures for using the Compliance Software for compliance with the Building Energy Efficiency Standards. The supplement shall provide instructions for preparing the building input, using the correct fixed and restricted inputs, and for using each of the optional capabilities for which the Compliance Software is approved. Also included are procedures for generating the standard reports and documenting the analysis. A sample of a properly documented building analysis shall be included.

All Compliance Supplements shall be written in a clear and concise manner and with an organization and format that will allow users to quickly locate the topic and understand the instructions. Also, vendors of approved Compliance Software are required to make copies of their compliance supplement available to all building departments in California.

The following sections describe the information that shall be included in all compliance supplements. It also presents the required organization for that information.

7.1 Energy Commission Approval

This section includes a copy of the official Energy Commission notice of approval of the Compliance Software. The notice may include restrictions or limitations on the use of the Compliance Software. It will also include the date of approval, and may include an expiration date for approval as well. The notice will indicate which optional capabilities the Compliance Software is approved for and other restrictions on its use for compliance. The Energy Commission will provide this notice upon completion of evaluation of the Compliance Software application.

7.2 Software Capabilities

This section discusses the program capabilities, with supporting written material explaining, as necessary, how the Compliance Software treats each one. Reference may be made to non-compliance sections of the Compliance Software Users Manual for more complete descriptions, if they exist.

7.3 Standard Input/Output Report

Inputs files shall be organized so that data is presented in the same order as that used by the required output reports.

7.4 Fixed and Restricted Inputs

Approved Compliance Software shall automatically use the standard fixed and restricted inputs for the standard design run. It shall also default to the standard assumptions for the proposed design run. When

alternative fixed and restricted inputs are used for the proposed design run, the Compliance Software shall report this in the *Special Features and Modeling Assumptions* sections of the standard reports.

This section of the Compliance Supplement explains the fixed and restricted inputs and how they are invoked in the Compliance Software. This is especially important if the Compliance Software offers the possibility of non-compliance runs which can deviate from the fixed and restricted inputs.

7.5 Preparing Basic Input

This section covers the basic use of the Compliance Software for compliance. Optional capabilities are described in greater detail. Reference may be made to the users' manual, but this section should include a complete summary of all inputs and/or commands necessary for compliance.

7.6 Optional Capabilities

This section explains the procedures for using each of the optional capabilities of the Compliance Software. It is a parallel section to the basic inputs section above. The section for each optional capability should explain how to prepare inputs, how to document assumptions, and what the limitations are of each analysis capability.

7.7 Special Features and Modeling Assumptions

This section explains the use of the Special Features and Modeling Assumptions listing to highlight the importance of verifying the special features and the aspects of those features that were modeled to achieve compliance.

7.8 Field Verification

This section explains the use of the Field Verification and Diagnostic Testing listing to highlight the special features that require diagnostic testing by a certified home energy rater under the supervision of an Energy Commission approved HERS provider to assure proper installation and verification. This section may rely on the information provided in Reference Residential Appendix RA3, and other sections of this manual, or may refer to other Commission documents.

7.9 Checklist for Compliance Submittal

This section should contain a concise checklist of all items that shall be included in a compliance submittal to a building official using the Compliance Software.

7.10 Sample Compliance Documentation

This section should include a complete set of compliance documentation for a sample building. The building need not be overly complex, nor need it include every software capability. The example should, however, include all documentation and standard reports that would normally be submitted. This example will serve as a model to Compliance Software users and building officials of what a proper compliance submittal should look like.

7.11 Compliance Statement

The following statement shall appear within the first several pages of the Supplement:

[Compliance Software Name] may be used to show compliance with California's Residential Building Energy Efficiency Standards.

7.12 Related Publications

The Compliance Supplement should refer users to the following related Energy Commission publications and where to obtain them:

- *2008 Building Energy Efficiency Standards* (P400-08-001F)
- *2008 Residential Compliance Manual* (publication number unknown at time of printing)

Both publications are available from:

California Energy Commission
Publications Unit
1516 Ninth Street
Sacramento CA 95814
(916) 654-5200